

CLAIMS

1. A water sump structure comprising:
 - a substantially water impermeable member for causing water to
5 become trapped; and
 - one or more heat exchange pipes for carrying a heat exchange fluid
and located, in use, so as to pass through water trapped by the impermeable
member.
- 10 2. A structure as claimed in Claim 1, in which the structure comprises a
channel through which the or each heat exchange pipe passes.
3. A structure as claimed in Claim 2, in which the channel comprise the water
impermeable member.
- 15 4. A structure as claimed in Claim 1 or Claim 2, in which the impermeable
member comprises a layer of water impermeable material.
5. A structure as claimed in Claim 4 when dependent on Claim 2, in which the
20 water impermeable layer lines at least part of the channel.
6. A structure as claimed in any of Claims 2 to 5, in which the channel
comprises a ground trench.

7. A structure as claimed in any preceding Claim, in which the impermeable member comprises a flexible membrane.
8. A structure as claimed in any preceding Claim, in which the impermeable member comprises a rigid trough member.
9. A structure as claimed in Claim 8 when dependent on Claim 2 or any Claim dependent thereon, in which the trough member forms the channel or a liner therefor.
10. A structure as claimed in Claim 8 or Claim 9, in which the trough member is formed from a material having a high thermal conductivity.
11. A structure as claimed in any preceding Claim, in which in use the structure is subterranean.
12. A structure as claimed in any preceding Claim, in which the structure further comprises primary particulate material through which the or each heat exchange pipe passes.
13. A structure as claimed in Claim 12, in which the particulate material comprises crushed rock.

14. A structure as claimed in Claim 12 or Claim 13, in which the primary particulate material is overlaid by a water permeable layer of secondary particulate material.
- 5 15. A structure as claimed in Claim 14, in which the secondary particulate material comprises crushed rock.
16. A structure as claimed in Claim 14 or Claim 15 when dependent on Claim 12 or Claim 13, in which the size of the secondary particles is greater than
10 the size of the primary particles.
17. A structure as claimed in any preceding Claim, in which a water permeable wear surface is formed above the water permeable member.
- 15 18. A structure as claimed in Claim 17 when dependent on any of Claims 14 to 16, in which the permeable wear surface is formed over the water permeable layer of secondary particulate material.
19. A structure as claimed in Claim 17 or Claim 18, in which the permeable
20 wear surface comprises a pavement structure.
20. A structure as claimed in any preceding Claim, in which there are provided a plurality of heat exchange pipes.

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21. A structure as claimed in Claim 20, in which the pipes are mutually spaced.
22. A structure as claimed in any preceding Claim, in which the or each heat exchange pipe is buried approximately 1.5 metres below the surface of the ground in use.
23. A structure as claimed in any preceding Claim, in which there are provided one or more diverter members positioned so as direct water to be trapped by the impermeable membrane in use.
24. A structure as claimed in Claim 23, in which the or each directing member comprises a sheet of water impermeable membrane arranged to funnel water into the channel.
25. A structure as claimed in any preceding Claim, further comprising a unidirectionally water permeable layer positioned to prevent evaporation of trapped water.
26. A structure as claimed in Claim 25, in which the unidirectionally water permeable layer comprises a fabric.

27. A water sump structure comprising:

- an excavated ground trench in-filled with primary particulate material for holding water; and
- one or more heat exchange pipes carrying heat exchange fluid and embedded in the primary particulate material.

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28. A structure as claimed in Claim 27, in which the trench is or is adapted to be substantially water impermeable whereby to retain water therein.

10 29. A structure as claimed in Claim 27 or Claim 28, in which the trench is lined with a substantially water impermeable liner member.

30. A method of forming a water pump structure, comprising the steps of:

- providing a substantially water impermeable member for trapping water;
- providing one or more heat exchange pipes carrying a heat exchange fluid; and
- passing the or each heat exchange pipe through an area in which water trapped by the impermeable member will collect in use.

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31. A method as claimed in Claim 30, in which the structure comprises a channel through which the or each heat exchange pipe passes.

32. A method as claimed in Claim 31, in which the water impermeable channel comprises the water impermeable member.
33. A method as claimed in Claim 30, in which the water impermeable member
5 comprises a layer of water impermeable material.
34. A heat exchange structure as claimed in Claim 33 when dependent on Claim 31, in which the water impermeable layer lines at least part of the channel.
- 10 35. A method as claimed in Claim 31, in which the channel is formed at least in part by excavating a ground trench.
36. A method as claimed in Claim 31, comprising the step of providing a
15 trough member which comprises the channel or forms a liner therefor.
37. A method as claimed in any of Claims 30 to 36, in which the structure is formed so as to be subterranean in use.
- 20 38. A method as claimed in any of Claims 31 to 37, further comprising the step of filling the channel with primary particulate material.

39. A method as claimed in Claim 38 or Claim 39, further comprising the step of overlaying the primary particulate material with a water permeable layer of secondary particulate material.
- 5 40. A method as claimed in Claim 38 or Claim 39, further comprising the step of forming a water permeable wear surface above the particulate material.
41. A method as claimed in Claim 40 when dependent on Claim 39, in which the water permeable wear surface is formed over the water permeable layer of particulate material.
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42. A method as claimed in any of Claims 30 to 41, further comprising the step of positioning one or more diverter members for directing water to be trapped by the impermeable member in use.
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43. A method as claimed in any of Claims 30 to 42, further comprising the step of providing a unidirectionally water permeable membrane to prevent evaporation of trapped water.
- 20 44. A heat pump system incorporating a structure of any of Claims 1 to 29.
45. A building which is heated/cooled by a heat pump system according to Claim 44.

46. A subterranean water sump structure comprising:
- a ground trench;
 - a substantially water impermeable member for causing water to become trapped in the trench;
- 5 in which a permeable wear surface is formed above the trench.
47. A structure as claimed in Claim 46, in which the permeable wear surface comprises a pavement structure.
- 10 48. A structure as claimed in Claim 46 or Claim 47, in which one or more heat exchange pipes for carrying a heat exchange fluid are located, in use, so as to pass through water trapped by the impermeable member.
49. A structure as claimed in any of Claims 46 to 48, in which the impermeable member comprises a flexible membrane.
- 15 50. A structure as claimed in any of Claims 46 to 48, in which the impermeable member comprises a rigid trough member.
- 20 51. A structure as claimed in any of Claims 46 to 50, in which the structure further comprises primary particulate material.
52. A structure as claimed in Claim 51, in which the particulate material comprises crushed rock.

53. A structure as claimed in Claim 51 or Claim 52, in which the primary particulate material is overlaid by a water permeable layer of secondary particulate material.
- 5 54. A structure as claimed in Claim 53, in which the secondary particulate material comprises crushed rock.
55. A structure as claimed in Claim 53 or Claim 54 when dependent on Claim 51 or Claim 52, in which the size of the secondary particles is greater than
10 the size of the primary particles.
56. A structure as claimed in any of Claims 46 to 55, in which there are provided one or more diverter members positioned so as to direct water to be trapped by the impermeable membrane in use.
- 15 57. A structure as claimed in Claim 56, in which the or each directing member comprises a sheet of water impermeable membrane arranged to funnel water into the channel.
- 20 58. A structure as claimed in any of Claims 46 to 57, further comprising a uni-directionally water impermeable layer positioned to prevent evaporation of trapped water.
59. A structure as claimed in Claim 58, in which the uni-directionally water
25 permeable layer comprises a fabric.